Total and methylmercury concentrations in Canadian alpine proglacial rivers (Banff and Jasper National Parks)

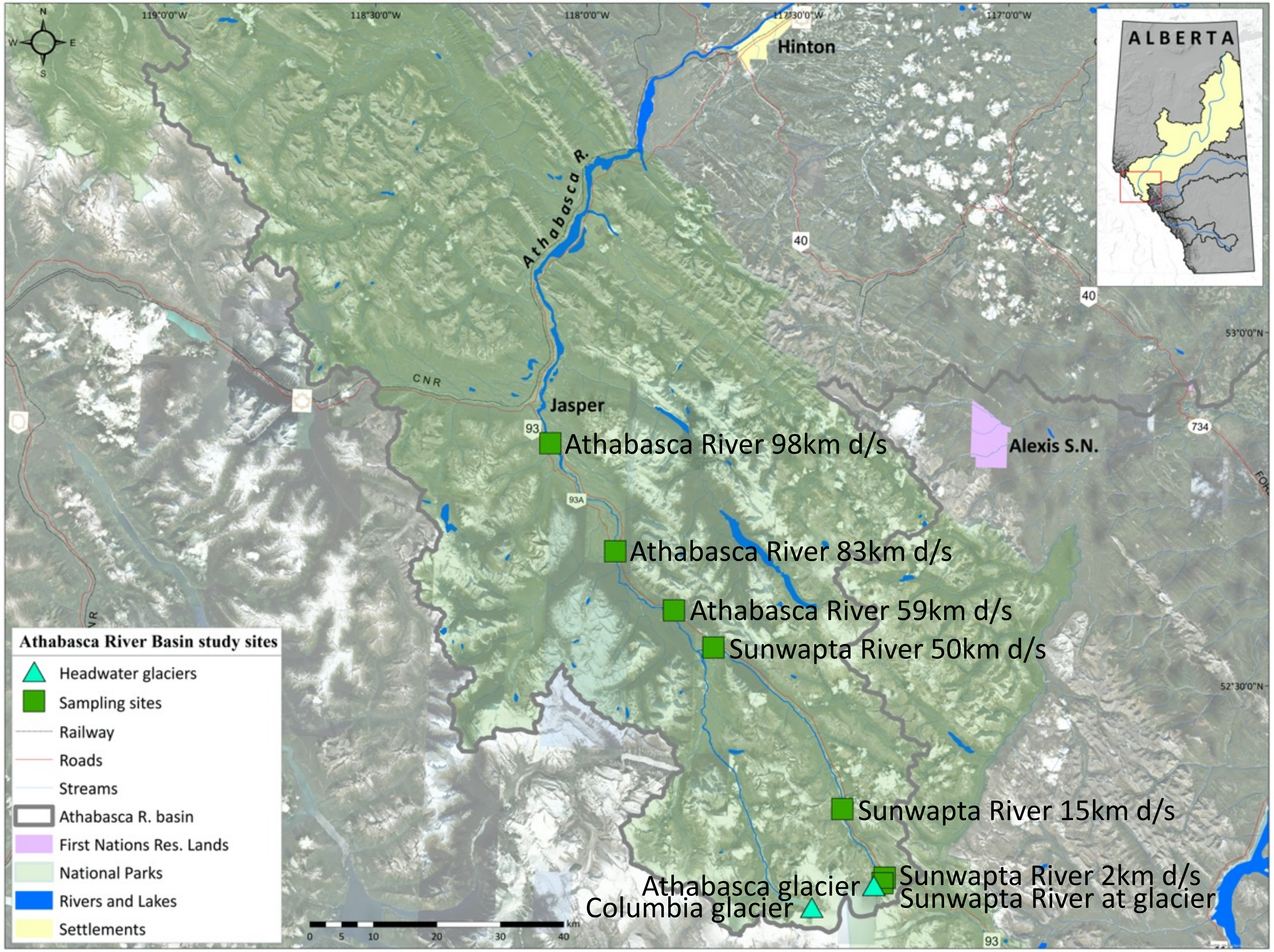
J. A. Serbu[1*], V. L. St.Louis[1], C. A. Emmerton[1], S. J. A. Enns[1]

[1]University of Alberta, *Contact: serbu@ualberta.ca

Introduction

- Glacial melt is releasing inorganic mercury (Hg) and toxic methylmercury (MeHg) previously deposited on glaciers from anthropogenic emissions[1,2], or naturally derived from underlying bedrock, into proglacial rivers
- As inorganic Hg moves downstream, it can also be transformed into MeHg that can biomagnify in the watershed's food web[3]
- We sampled for concentrations of total Hg (THg; all forms of Hg) and MeHg along four main rivers in the Canadian Rocky Mountains from May to October 2019
- The goal was to assess the riverine fluxes of Hg originating from glacial melt and how unfiltered and filtered concentrations of Hg change as they moved downstream in these systems

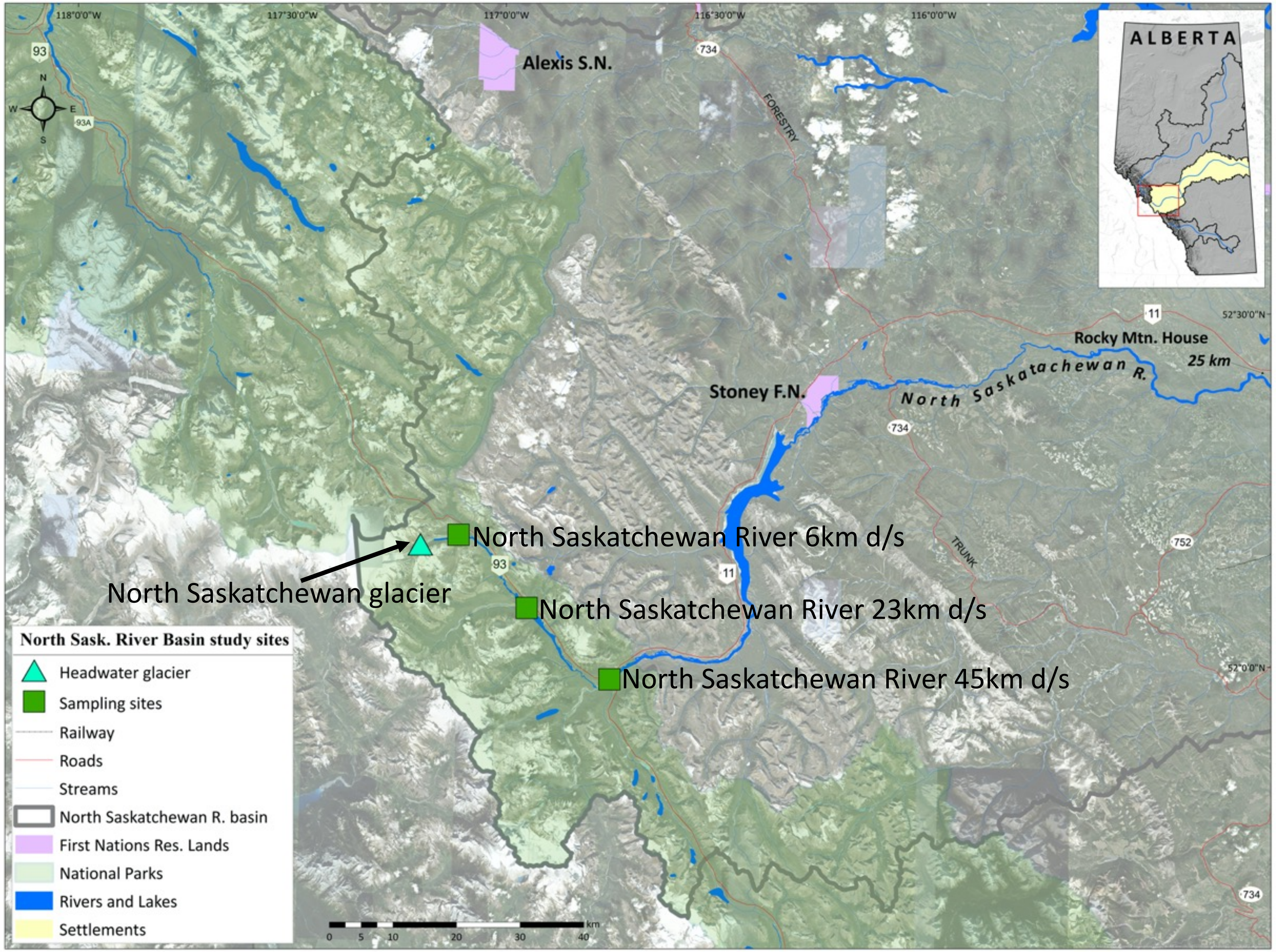
Sunwapta and Athabasca Rivers



d/s = downstream of glacier

- We sampled 4 sites along the Sunwapta River which originates from the Athabasca glacier in Jasper National Park (JNP)
- We also sampled 3 sites along the Athabasca River, which stems from the Columbia glacier in JNP. The furthest site was nearly 100km downstream of the glacial termini

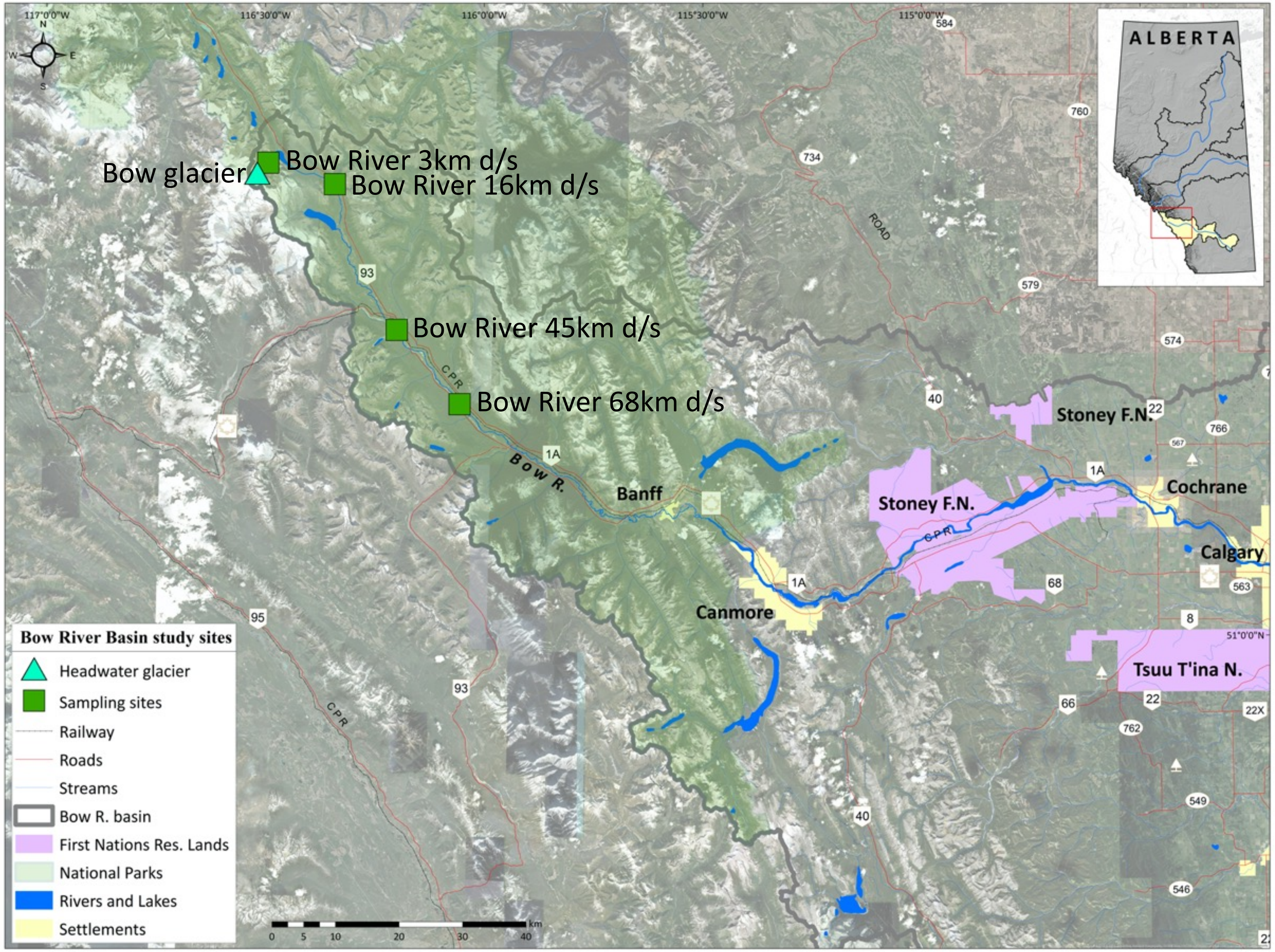
North Saskatchewan River



- The Saskatchewan glacier feeds the North Saskatchewan River, along which we had 3 study sites

- Though close to the Athabasca and Sunwapta rivers in proximity, the North Saskatchewan River is south of the JNP boundary and begins in Banff National Park (BNP)

Bow River



- We had 4 sample sites along the Bow River which flows from Bow glacier in BNP, and was the only river in our study that did not originate in the Columbia Icefields
- Bow Lake, between our first and second sites, is a large subalpine lake and could be an important area of Hg methylation activity

Methods

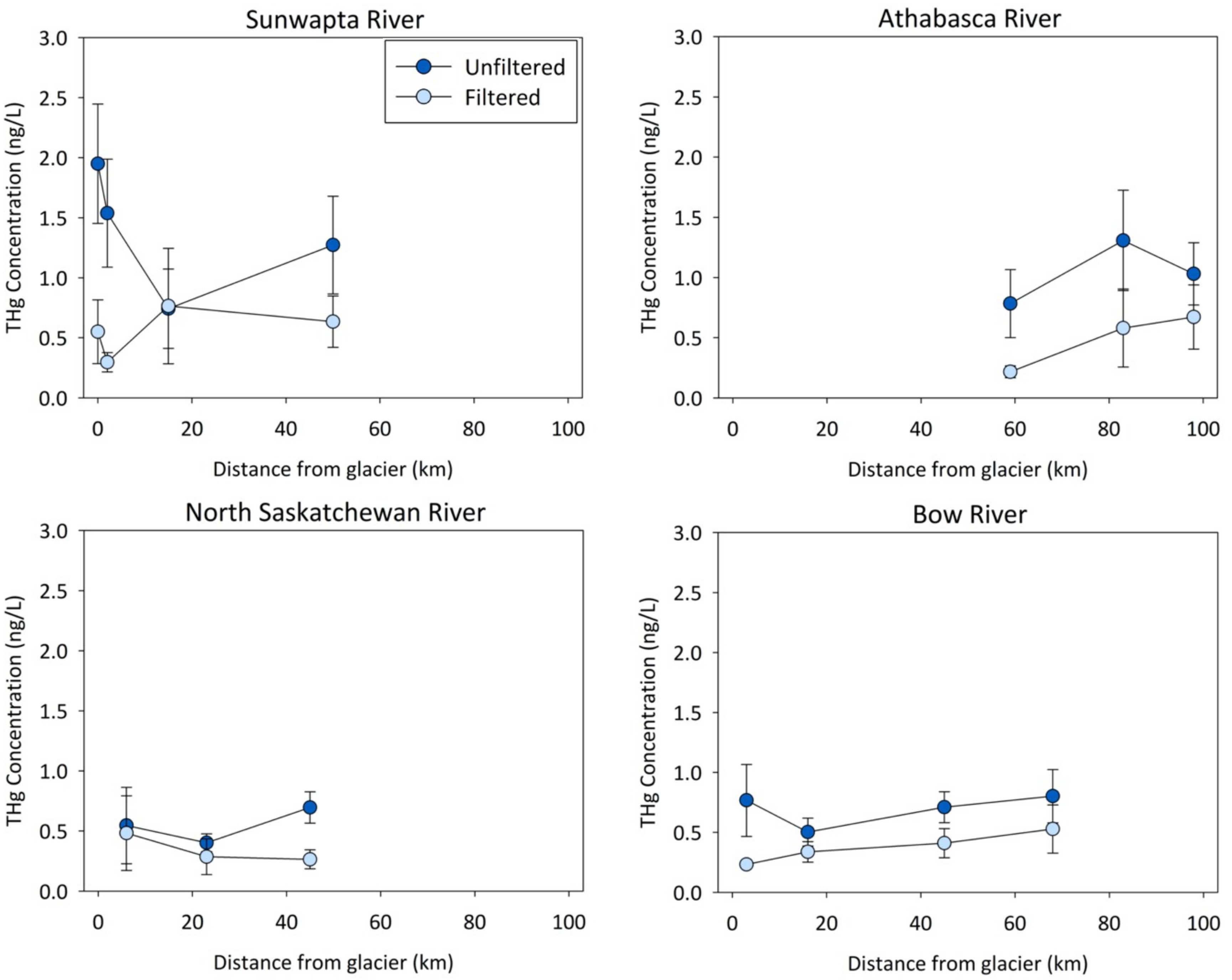
- At each site, we collected water following the "clean hands-dirty hands" sampling protocol (Figure A)
- In our field lab (Figure B), we filtered half the samples through 0.45µm pre-acid washed Nalgene filter towers to also obtain a filtered fraction (fTHg and fMeHg)
- Analyses were conducted at the accredited Biogeochemical Analytical Service Laboratory at the University of Alberta

Table 1. Preservation and method of analysis for Hg parameters

Parameter	% HCl	Method of Analysis
THg/fTHg	0.2	Tekran 2600 Mercury Analyzer
MeHg/fMeHg	0.4	Tekran 2750 Methyl Mercury Distillation Unit coupled to an Agilent 7900 ICP-MS

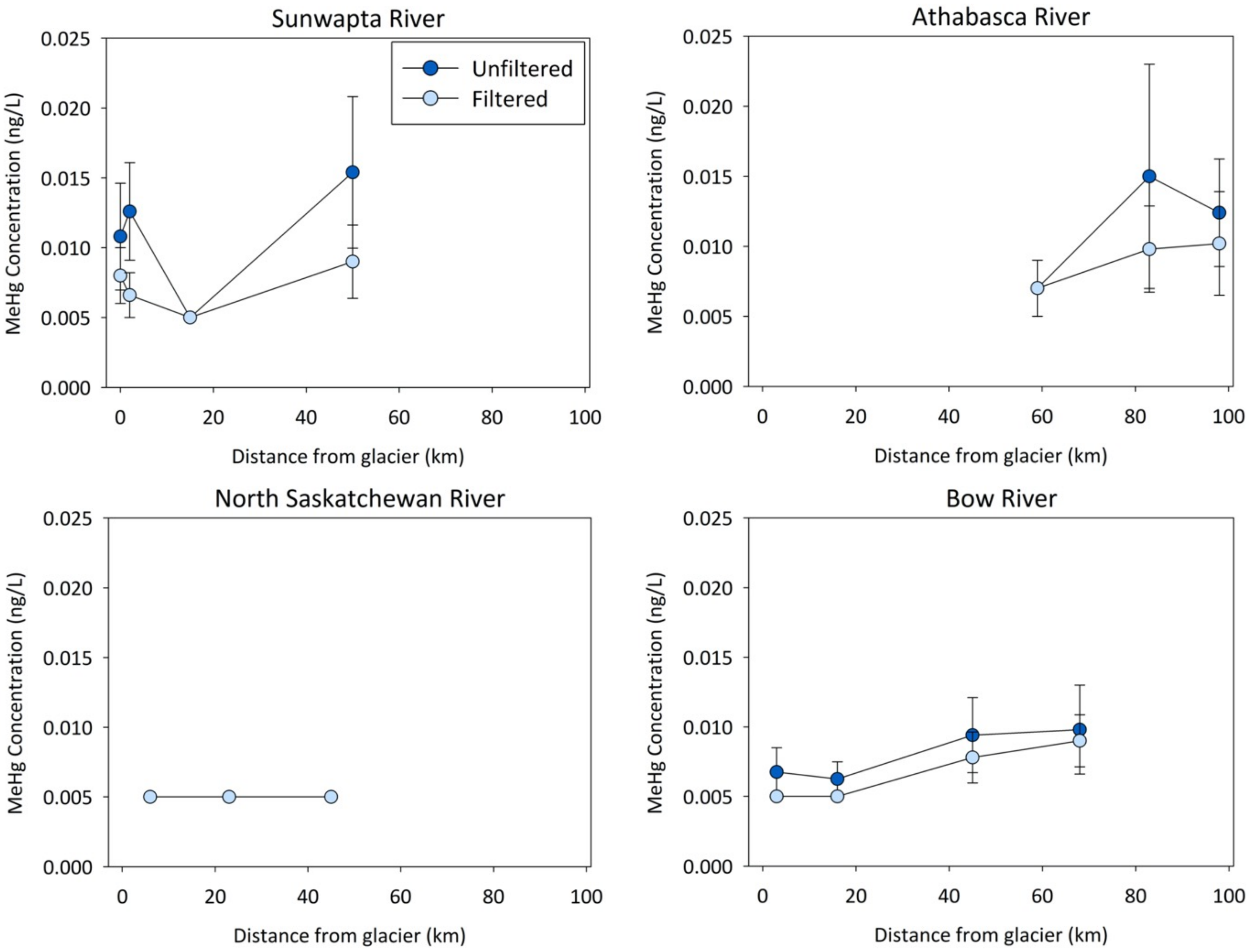
Results (THg)

- All rivers in our study had low mean ± SE [THg], comparable to other undisturbed Canadian rivers[4]
- [THg] often decreased from the first proglacial site before increasing slightly at sites further downstream
- [fTHg] tended to increase with increasing distance from glacier



Results (MeHg)

- [MeHg] and [fMeHg] were consistently at or near our analytical reportable detection limit of 0.005 ng/L
- Despite this, the data shows that [fMeHg] did follow the same general trend as [MeHg] along the rivers



Discussion

- Hg can have negative impacts on freshwater quality, organisms in the watershed, and downstream human populations
- However, our low [MeHg] results suggest little net MeHg deposition or net Hg methylation in this system
- Our data also suggests that particulate-bound THg tended to decrease along the transects, possibly owing to the settlement of glacial sediment downstream of the glacial termini
- The next step is to collect a second year of data to confirm our results, and measure river discharge so Hg fluxes to downstream ecosystems such as lakes can be calculated

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